International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 7, Issue 2, Apr 2017, 23-30

TRANS STELLAR
•Journal Publications •Research Consultancy

INFLUENCE OF ORGANIC, INORGANIC AND BIO-FERTILIZER SOURCES ON DIFFERENT SPACING FOR VEGETATIVE GROWTH AND FRUIT YIELD OF GUAVA (CV. LALIT)

R. KIRAN KUMAR[1], S. JAGANATH[2], T. R. GURUPRASAD[3] & MOHAMAD TAYEEB ULLA, H[4]

[1,2]*College of Horticulture, UHS Campus, Bengaluru, Karnataka, India*

[3]*Zonal Horticulture Research & Extension Center, Bangalore, Karnataka, India*

[4]*College of Horticulture, UHS Campus, Bengaluru, Karnataka, India*

ABSTRACT

The Field investigations were carried out know the effect of organic, inorganic and bio-fertilizers on growth and yield of guava (Psidium guajava L.) cv. Lalit" was carried out at Regional Horticulture Research Station, College of Horticulture, Bengaluru, India. The vegetative growth and yield was significantly influenced at different spacing levels (2×2, 3×3, 6×3 and 6×6 m^2). In rainy season the maximum plant height (2.81 m), plant spread (N-S direction) (2.85 m), plant spread (E-W direction) (2.69 m) and canopy volume (11.76 m^3) were found in 6×6 m^2 spacing. Whereas, the maximum leaf area (58.13 m^2) and total chlorophyll content (2.19 mg 100 g^{-1} FW) were found in 2×2 m^2 spacing. Integrated nutrient management significantly influenced vegetative growth characteristics after 8th month of growth stage the maximum plant height (2.81 m), plant spread (N-S direction) (2.74 m), plant spread (E-W direction) (2.67 m) and canopy volume (11.71 m^3) in 6×6 m^2 spacing and the (2×2 m^2) spacing records, the maximum leaf area (59.12 m^2) and total chlorophyll content (2.53 mg 100 g^{-1} FW) were maximum in (T_{10}) Azotobacter @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK. The yield was significant among the different spacing of rainy season. The 6×6 m^2 spacing records the maximum number of fruits (171.74), fruit yield (12.63 kg $tree^{-1}$). Integrated nutrient management of (T_{10}) Azotobacter @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK wangle the maximum number of fruits (236.06), fruit yield (15.71 kg $tree^{-1}$).

KEYWORDS: Organic, Inorganic and Bio-Fertilizers, Guava, Vegetative Growth & Yield

Received: Jan 05, 2017; **Accepted:** Feb 07, 2017; **Published:** Feb 11, 2017; **Paper Id.:** IJASRAPR20174

Original Article

INTRODUCTION

Guava (*Psidium guajava* L.) is a popular fruit crop in India. It can be grown in tropical and subtropical climate fruits are highly nutritious, which were rich in vitamin 'C' Sharma et al. (2013). The integrated approach of organic, inorganic and bio-fertilizers were used to know the effect on vegetative growth and its impact on yield parameters of cv. Lalit in rainy season.

MATERIALS AND METHODS

The present research was carried out at the Regional Horticultural Research Experimental Centre (RHREC), UHS, Campus, Bengaluru during the year 2012–13 and 2013–14 and the research was conducted on three year old guava trees. Experiment was conducted on four different plant densities included, (2×2 m^2, 3×3 m^2, 6×3 m^2 and 6×6 m^2. The treatment aggregates of T_1: FYM (10 kg)+recommended NPK (50:25:75 g $plant^{-1}$),

T_2: Vermicompost (10 kg)+recommended NPK, T_3: FYM (5 kg)+vermicompost (5 kg)+recommended NPK, T_4: FYM (10 kg)+vermicompost (10 kg)+50% recommended NPK, T_5: *Azotobacter* (20 g)+FYM (10 kg)+50% recommended NPK, T_6: *Azotobacter* (20 g)+vermicompost (10 kg)+50% recommended NPK, T_7: PSB (20 g)+FYM (10 kg)+50% recommended NPK, T_8: PSB (20 g)+vermicompost (10 kg)+50% recommended NPK, T_9: *Azotobacter* (20 g)+PSB (20 g)+FYM (10 kg)+50% recommended NPK, T_{10}: *Azotobacter* (20 g)+PSB (20 g)+vermicompost (10 kg)+50% recommended NPK. The bio-fertilizers were procured from Department of Microbiology, UAS, Bengaluru, India. The experiment was statistically carried out by split plot design with ten treatments replicated thrice with two trees replication^{-1}. The observations recorded for vegetative growth, plant height (m) and plant spread (N-S & E-W), Canopy volume was calculated by using formula by Roose et al., 1986

$$V = \frac{4}{6}\pi h r^2$$

Where, π–2.14, h-Height of tree (m),

$$r = \frac{\text{Sum of E–W and N–S directions (m)}}{4}$$

Leaf area, total chlorophyll content of leaf, number of fruits, fruit yield tree^{-1}. The data were statistically analyzed by adopting standard procedures and interpreted using analysis of variance.

RESULTS AND DISCUSSIONS

The plant height was recorded in different densities like S_1 (2×2 m^2), S_2 (3×3 m^2), S_3 (6×3 m^2) and S_4 (6×6 m^2) of rainy (2013) at initial days among the different density the maximum plant height (2.36 m) recorded in 6×6 m^2 which was on par with 6×3 m^2 (2.29 m). Whereas, the other spacing shows significant results 3×3 m^2 recorded (2.15 m) and 2×2 m^2 (1.71 m), and after 8th months of growth period plant height (2.81 m) recorded in 6×6 m^2 which was on par with 6×3 m^2 (2.73 m). Whereas, the other spacing shows significant results the 3×3 m^2 recorded (2.55 m) and 2×2 m^2 (2.04 m) and the integrated nutrient management method also proves that, the plants treated with T_{10} (*Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK) shows highest plant height at initial days and after 8 months (2.36 & 2.81 m respectively). The plant spread was significantly higher (N–S and E–W) was observed in unprunned treatment (6×6 m^2) than all other high density spacing (2×2 m^2), (3×3 m^2), (6×3 m^2). The maximum spread (N-S) of plant at initial days 2×2 m^2 (1.56 m), 3×3 m^2 (2.09 m) shows significant differences with each other but 6×3 m^2 (2.31 m) was on par with 6×6 m^2 (2.40 m) and after 8 months of growth period 2×2 m^2 (1.86 m), 3×3 m^2 (2.48 m) shows significant differences with each other but 6×3 m^2 (2.75 m) was on par with 6×6 m^2 (2.85 m). Where, by the application of organic and inorganic with bio-fertilizers sources were significantly influenced on plant spread (N-S) (2.30 and 2.74 m) was observed at initial days and at 8th months respectively. Similar trend was followed in the East-West spread plant spread where, the significantly maximum spread was observed in unpruned spacing S_4 (6×6 m^2) (2.26 m) which was on par with 6×3 m^2 and with other spacing 2×2 m^2 (2.13 m) and 3×3 m^2 (1.56 m) it shows significant differences were observed at initial days of growth period and it was maximum over rest of the densities. Whereas, in integrated management studies, the maximum spread was observed in T_{10} (*Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK) (2.24 m and 2.67 m) at initial days and after 8th month of growth period. The maximum canopy volume was observed at (S_4) 6×6 m^2 (6.96 m^3) which was on par with 6×3 m^2 (6.48 m^3) but it was significant with 3×3 m^2 (5.26 m^3) and 2×2 m^2 (2.28 m^3) at initial days and after at 8th month (S_4) 6×6 m^2 (11.76 m^3) which was on par with 6×3 m^2

(10.95 m^3) but it was significant with 3×3 m^2 (8.89 m^3) and 2×2 m^2 (3.85 m^3) was observed. Further, T_{10} comprises with *Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK had maximum canopy volume (6.93 m^3 and 11.71 m^3 respective interval of growth stage) compared to T_9 (*Azotobacter* @ 20 g+PSB @ 20 g+FYM @ 10 kg+50% recommended NPK) (6.19 and 10.45 m^3 respectively) (Table 1 & 2).

The leaf area of a plant was influenced by the different spacing 2×2 m^2 spaced plants shows the maximum leaf area (58.13 m^2) among all other densities, apart from the spacing treatment the integrated nutrient management resulted maximum leaf area (59.12 m^2) observed in T_{10} (*Azotobacter* @ 20 g+PSB @ 20 g vermicompost @ 10 kg+50% recommended NPK. Maximum total chlorophyll content of the leaves was recorded significantly more in closer spaced (2×2 m^2) plots (2.19 mg 100 g^{-1} fresh weight). By the application of organic, inorganic and bio-fertilizers, the synthesis of total chlorophyll content of leaves was maximum in the treatment T_{10} (*Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK) (2.53 mg 100 g^{-1} fresh weight) in the rainy season (Table 3).

The maximum number of fruits (171.74) was in rainy season under wider spaced (6×6 m^2) plots. By the application of organic, inorganic and bio-fertilizers, the number of fruits was maximum (236.06) in the treatment T_{10} (*Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK) and the maximum fruit yield $tree^{-1}$ in the higher fruit yield $tree^{-1}$ was recorded under (6×6 m^2) spacing with the yield about (12.63 kg $tree^{-1}$). The adaptation of integrated nutrient management gives the maximum fruit yield (15.71 kg $tree^{-1}$) in the treatment (T_{10}) *Azotobacter* @ 20 g+PSB @ 20 g+vermicompost @ 10 kg+50% recommended NPK (Table 4).

The results of present study reveals the variations in plant height is may be due to the regular pruning was undertaken as a common practice for all high density treatment except the wider spaced plot. Thus, more or less similar dwarf plant height was observed in the entire high density plot. On the other side, the highest plant was observed in wider spacing plot. S_4 (6×6 m^2) plant growth was not restricted by adopting pruning. These results were confirmed by earlier reports of guava high density studies where, Bal and Dhaliwal (2003) reported that a spacing of 6×6 m^2 resulted the maximum tree height as compared to 6×4 m^2 and 6×5 m^2 spacing. The high density was coupled with the regular pruning however, some studies without pruning were conducted by many researches like, Kundu (2007), Singh et al. (2007), Lal et al. (2007) and Brar et al. (2010). They recorded that height of the plant was increased in the plant densities or closer spacing, and these increment in height of plant in these research find outs was mainly due to the fact that sunlight competition among the unprunned high density plants grows vertically.

The better efficiency of organic manures in combination with inorganic fertilizers might be due to the fact that organic manures would have provided the micronutrients such as zinc, iron, copper, manganese, etc., in an optimum level. These findings were supported by following researchers work, the application of organic manures would have helped in the plant metabolism through the supply of such important micronutrients in the early growth phase. (Barani and Anburani, 2004). The maximum plant spread was noticed in 6×6 m^2 spacing. Improvement of crop growth was influenced by *Azotobacter*, the microbial inoculants, which bring about fixation of atmospheric nitrogen through free-living N_2 fixers in rhizosphere. The results of present study accordance with Pathak and Ram (2005) were observed the vegetative growth of guava was improved by the application of different fertilizers, organic manure and bio-fertilizers. The increasing of canopy volume might be due to the better nutritional environment, application of organic matter improve the soil health by improving physicochemical and biological activities of soil (Shukla et al., 2009). The favorable effect of vermicompost on vegetative growth might be due to the fact that in addition to improving the various aspects of soil systems

(physico-chemical and biological), it also alters various enzymatic activities in plants such as peroxidase, catalase etc., which promotes cell elongation, root and shoot growth and carbohydrate metabolism (Schnitzer, 1991). The productivity of any crop depends on the process of photosynthesis, which in turn depends on the chlorophyll content of leaves in plants and the magnesium is an important constituent of chlorophyll. They help in activation of many enzymes involved in photosynthesis their by, helps in uptake and translocation of sugar in the plant. The maximum growth increment was obtained by the application of full dose of NPK with bioincoulants followed by 75% NPK with bioincoulants and vermincompost, it might be due to profuse supply of nutrients along with production of growth promoting hormones by bio-fertilizers and vermicompost. (Hari Baksh et al., 2009). The finding of Peng and Qin, (1993) indicated that the total chlorophyll content and photosynthetic rate of leaves were positively correlated with leaf N content.

Table 1: Effect of High Density Guava and Integrated Nutrient Management on Plant Height (m) and Plant Spread (N-S Direction) (m)

Treatments	Plant Height (m)										Plant Spread (N-S)									
	Initial Days				Mean	After 8th Months				Mean	Initial Days				Mean	After 8th Months				Mean
	S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4	
T_1	1.49	1.56	2.14	2.22	1.85	1.78	1.85	2.55	2.65	2.21	1.26	1.86	1.96	2.10	1.79	1.50	2.21	2.33	2.50	2.14
T_2	1.57	1.99	2.15	2.28	2.00	1.87	2.37	2.56	2.72	2.38	1.50	1.89	2.24	2.17	1.95	1.79	2.25	2.67	2.58	2.32
T_3	1.64	2.04	2.22	2.29	2.05	1.95	2.43	2.65	2.73	2.44	1.51	1.91	2.25	2.28	1.99	1.80	2.28	2.68	2.72	2.37
T_4	1.70	2.08	2.25	2.32	2.09	2.02	2.48	2.68	2.76	2.49	1.55	2.06	2.28	2.35	2.06	1.85	2.45	2.71	2.80	2.45
T_5	1.73	2.22	2.29	2.32	2.14	2.06	2.64	2.72	2.76	2.55	1.57	2.12	2.29	2.39	2.09	1.87	2.53	2.73	2.85	2.49
T_6	1.72	2.22	2.31	2.34	2.15	2.04	2.64	2.75	2.78	2.56	1.58	2.17	2.35	2.45	2.13	1.88	2.58	2.79	2.91	2.54
T_7	1.75	2.25	2.30	2.37	2.17	2.08	2.68	2.74	2.82	2.58	1.61	2.18	2.36	2.47	2.16	1.92	2.59	2.81	2.95	2.57
T_8	1.82	2.25	2.35	2.46	2.22	2.16	2.68	2.80	2.93	2.64	1.65	2.19	2.38	2.49	2.18	1.96	2.61	2.83	2.97	2.59
T_9	1.82	2.26	2.44	2.49	2.25	2.16	2.69	2.91	2.97	2.68	1.68	2.20	2.47	2.55	2.23	2.00	2.62	2.95	3.03	2.65
T_{10}	1.88	2.59	2.46	2.50	2.36	2.24	3.09	2.93	2.97	2.81	1.69	2.29	2.50	2.70	2.30	2.02	2.73	2.98	3.22	2.74
Mean	1.71	2.15	2.29	2.36		2.04	2.55	2.73	2.81		1.56	2.09	2.31	2.40		1.86	2.48	2.75	2.85	
	SEm±		CD @ 5%			SEm±		CD @ 5%			SEm±		CD @ 5%			SEm±		CD @ 5%		
S	0.02		0.08			0.03		0.09			0.03		0.10			0.03		0.12		
T	0.01		0.02			0.01		0.02			0.01		0.02			0.01		0.02		
S×T	0.03		0.07			0.03		0.08			0.03		0.09			0.04		0.10		

T_1: FYM (10 kg)+recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g)+vermicompost (10 kg)+50% recommended NPK
T_2: Vermicompost (10 kg)+recommended NPK	T_7: PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_3: FYM (5 kg)+vermicompost (5 kg)+recommended NPK	T_8: PSB (20 g)+vermicompost (10 kg)+50% recommended NPK
T_4: FYM (10 kg)+vermicompost (10 kg)+50% recommended NPK	T_9: *Azotobacter* (20 g)+PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_5: *Azotobacter* (20 g)+FYM (10 kg)+50% recommended NPK	T_{10}: *Azotobacter* (20 g)+PSB (20 g)+vermicompost (10 kg)+50% recommended NPK

S_1: 2×2 m^2	S_2: 3×3 m^2	S_3: 6×3 m^2	S_4: 6×6 m^2

Table 2: Effect of High Density Guava and Integrated Nutrient Management on Plant Spread (E-W Direction) (m) and Canopy Volume (m^3)

Treatments	Plant Spread (E-W)										Canopy Volume (m^3)									
	Initial Days				Mean	After 8th Months				Mean	Initial Days				Mean	After 8th Months				Mean
	S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4		S_1	S_2	S_3	S_4	
T_1	1.35	1.87	2.51	2.05	1.94	1.61	2.22	2.99	2.44	2.31	1.38	2.91	5.78	5.16	3.81	2.33	4.92	9.77	8.71	6.43
T_2	1.37	1.92	2.21	2.08	1.89	1.64	2.28	2.63	2.47	2.26	1.75	3.89	5.76	5.56	4.24	2.96	6.57	9.73	9.39	7.16
T_3	1.54	1.95	2.39	2.18	2.01	1.84	2.32	2.84	2.60	2.40	2.07	4.11	6.47	6.17	4.70	3.50	6.94	10.92	10.42	7.95
T_4	1.56	2.02	2.26	2.21	2.01	1.86	2.41	2.69	2.63	2.40	2.23	4.69	6.27	6.51	4.92	3.76	7.91	10.58	11.00	8.31
T_5	1.57	2.09	2.08	2.26	2.00	1.87	2.49	2.47	2.69	2.38	2.30	5.33	5.90	6.78	5.08	3.89	8.99	9.97	11.46	8.58
T_6	1.59	2.12	2.05	2.29	2.01	1.90	2.52	2.44	2.73	2.40	2.33	5.52	6.02	7.08	5.24	3.93	9.33	10.17	11.96	8.85
T_7	1.60	2.19	2.18	2.30	2.07	1.90	2.61	2.60	2.74	2.46	2.43	5.81	6.41	7.29	5.49	4.11	9.81	10.83	12.31	9.27
T_8	1.67	2.30	2.30	2.33	2.15	1.99	2.74	2.74	2.78	2.56	2.70	6.11	6.95	7.74	5.87	4.56	10.33	11.73	13.07	9.92
T_9	1.67	2.35	2.29	2.39	2.17	1.99	2.80	2.73	2.84	2.59	2.75	6.33	7.48	8.19	6.19	4.65	10.68	12.64	13.83	10.45
T_{10}	1.67	2.47	2.33	2.51	2.24	1.99	2.94	2.78	2.99	2.67	2.88	7.92	7.77	9.16	6.93	4.86	13.38	13.12	15.47	11.71
Mean	1.56	2.13	2.26	2.26		1.86	2.53	2.69	2.69		2.28	5.26	6.48	6.96		3.85	8.89	10.95	11.76	
	SEm±		CD @ 5%			SEm±		CD @ 5%			SEm±		CD @ 5%			SEm±		CD @ 5%		
S	0.025		0.09			0.03		0.10			0.43		1.48			0.72		2.50		
T	0.006		0.02			0.01		0.02			0.10		0.29			0.18		0.50		
S×T	0.028		0.08			0.03		0.09			0.47		1.33			0.80		2.25		

T_1: FYM (10 kg)+recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g)+vermicompost (10 kg)+50% recommended NPK
T_2: Vermicompost (10 kg)+recommended NPK	T_7: PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_3: FYM (5 kg)+vermicompost (5 kg)+recommended NPK	T_8: PSB (20 g)+vermicompost (10 kg)+50% recommended NPK
T_4: FYM (10 kg)+vermicompost (10 kg)+50% recommended NPK	T_9: *Azotobacter* (20 g)+PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_5: *Azotobacter* (20 g)+FYM (10 kg)+50% recommended NPK	T_{10}: *Azotobacter* (20 g)+PSB (20 g)+vermicompost (10 kg)+50% recommended NPK

S_1: 2×2 m^2	S_2: 3×3 m^2	S_3: 6×3 m^2	S_4: 6×6 m^2

Table 3: Effect of High Density Guava and Integrated Nutrient Management on Leaf Area (m^2) and Total Chlorophyll Content of Leaf (mg 100 g^{-1} FW)

Treatments	Leaf Area (m^2)					Total Chlorophyll				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
T_1	50.77	46.26	43.04	43.11	45.80	1.80	1.79	1.73	1.64	1.74
T_2	51.79	46.38	44.62	45.03	46.96	1.81	1.79	1.75	1.64	1.75
T_3	54.36	48.76	46.14	45.45	48.68	1.93	1.90	1.87	1.75	1.86
T_4	55.10	50.86	47.04	46.64	49.91	1.99	1.94	1.90	1.80	1.91
T_5	57.45	52.09	49.32	48.78	51.91	2.20	2.16	2.12	1.99	2.12
T_6	59.14	53.53	50.75	49.73	53.29	2.27	2.21	2.19	2.06	2.18
T_7	60.28	56.14	52.51	50.25	54.79	2.40	2.36	2.34	2.19	2.32
T_8	62.48	57.09	53.21	51.33	56.03	2.41	2.37	2.34	2.21	2.33
T_9	64.33	60.29	54.13	52.11	57.72	2.50	2.45	2.39	2.25	2.40
T_{10}	65.55	62.35	54.59	53.96	59.12	2.64	2.58	2.53	2.36	2.53
Mean	58.13	53.37	49.54	48.64		2.19	2.16	2.12	1.99	
	SEm±		CD @ 5%			SEm±		CD @ 5%		
S	0.96		3.33			0.002		0.008		
T	0.29		0.82			0.006		0.016		
S×T	1.11		3.12			0.011		0.031		

Table 4: Effect of High Density Guava and Integrated Nutrient Management on Number of Fruits and Fruit Yield (kg tree^{-1})

Treatments	Number of Fruits					Fruit Yield (kg tree^{-1})				
	S_1	S_2	S_3	S_4	Mean	S_1	S_2	S_3	S_4	Mean
T_1	73.48	60.32	86.33	82.25	75.59	2.73	3.16	4.67	4.77	3.83
T_2	82.25	80.06	104.18	108.57	93.77	4.05	4.09	5.55	6.20	4.97
T_3	95.41	104.18	122.83	104.18	106.65	4.03	5.04	6.64	8.37	6.02
T_4	104.18	108.57	137.08	130.50	120.09	5.26	5.68	7.96	9.29	7.05
T_5	114.05	152.44	154.63	176.56	149.42	6.42	7.18	8.74	13.13	8.87
T_6	137.08	159.02	156.82	191.92	161.21	6.55	8.07	10.97	14.14	9.93
T_7	165.60	167.79	154.63	205.08	173.27	6.59	8.66	14.00	15.35	11.15
T_8	198.50	176.56	205.08	213.85	198.50	8.45	9.09	15.03	16.43	12.25
T_9	176.56	191.92	233.59	244.56	211.66	10.21	9.54	16.23	18.32	13.58
T_{10}	216.04	213.85	254.43	259.91	236.06	12.68	11.59	18.28	20.27	15.71
Mean	136.32	141.47	160.96	171.74		6.70	7.21	10.81	12.63	
	SEm±		CD @ 5%			SEm±		CD @ 5%		
S	0.95		3.30			0.21		0.73		
T	1.53		4.30			0.15		0.43		
S×T	3.05		8.59			0.36		1.01		

T_1: FYM (10 kg)+recommended NPK (50:25:75 g plant^{-1})	T_6: *Azotobacter* (20 g)+vermicompost (10 kg)+50% recommended NPK
T_2: Vermicompost (10 kg)+recommended NPK	T_7: PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_3: FYM (5 kg)+vermicompost (5 kg)+recommended NPK	T_8: PSB (20 g)+vermicompost (10 kg)+50% recommended NPK
T_4: FYM (10 kg)+vermicompost (10 kg)+50% recommended NPK	T_9: *Azotobacter* (20 g)+PSB (20 g)+FYM (10 kg)+50% recommended NPK
T_5: *Azotobacter* (20 g)+FYM (10 kg)+50% recommended NPK	T_{10}: *Azotobacter* (20 g)+PSB (20 g)+vermicompost (10 kg)+50% recommended NPK

S_1: 2×2 m^2	S_2: 3×3 m^2	S_3: 6×3 m^2	S_4: 6×6 m^2

The integrated use of organic manures and bio-fertilizers along with chemical fertilizers improves physico-chemical properties of soil besides improving the efficiency of applied chemical fertilizers which helps in the betterment of yield and its other components, these results were in accordance with (Sharma et al., 2013). The bio-fertilizers encouraged better growth and accumulate optimum dry matter with induction of growth hormones, which stimulated cell division, cell elongation, activate the photosynthesis process, The similar findings were reported in guava Dey et al. (2005), Kumar et al. (2005) and Athani et al. (2007). Mishra and Pathak (1998) reported that 50% pruning in May produced the highest yield (25.8 kg tree^{-1}) than unpruned (7.6 kg tree^{-1}) in winter crop of guava cv. 'Sardar'. A significant increase in yield and yield parameters in guava with integrated nutrient application may be due to vigorous vegetative growth and increased chlorophyll content, which together accelerated the photosynthetic rate and thereby increased the supply of carbohydrates to plants. The beneficial role of supplemented organic manures and bio-fertilizers in improving soil physical, chemical and biological role is well known, which in turn helps in better nutrient absorption by plants and resulting higher yield (Prabu et al., 2002).

CONCLUSIONS

The present study represents the positive response of organic, inorganic manures and bio-fertilizers application played a vital role to increase the growth and yield of guava. The combined use of organic manures, bio-fertilizers and chemical fertilizers has been found not only in maintaining higher productivity but also in providing stable crop yields for sustainable crop production through integrated nutrient use.

REFERENCES

1. *Sharma, Wali, V. K., Bakshi, P., & Jasrotia, A. (2013). Effect of organic and inorganic fertilizers on quality and shelf life of guava (Psidium guajava L.) cv. Sardar. The Bioscan 8(4), 1247–1250.*
2. *Athani, S. I., Ustad, A. I., Prabhuraj, H. S., Swamy, G. S. K., Patil, P. B., & Kotikal, Y. K. (2007). Influence of vermicompost on growth, fruit yield and quality of guava cv. Sardar. Acta Horticulturae 735, 381–385.*
3. *Bal, J. S., & Dhaliwal, G. S. (2003). High density planting studies in guava. Haryana Journal of Horticulture Sciences 32(1&2), 19–20.*
4. *Barani, P., & Anburani, A. (2004). Influence of vermicompost on growth parameters in bhendi. South Indian Horticulture 52, 351–354.*
5. *Brar, J. S. (2010). Influence of paclobutrazol and ethephon on vegetative growth of guava (Psidium guajava L.) plants at different spacing. Notulae Scientia Biologicae 2(3), 110–113.*
6. *Dey, P., Rai, M., Kumar, S., Nath, V., Das, B., & Reddy, N. N. (2005). Effect of bio-fertilizers on physico-chemical characteristics of guava (Psidium guajava) fruit. Indian Journal of Agricultural Sciences 75, 95–96.*
7. *Hari Baksh, Yadav, R., & Dwivedi, R. (2008). Effect of INM on growth, yield attributing characters and quality of guava (P. guajava) cv. Sardar. Progressive Agriculture 8(2), 141–144.*
8. *Kumar, P., Tiwari, J. P., Lal, S. (2005). Effect of varying levels of N, P and K fertilization on plant growth, yield, and fruit quality and leaf nutrient status of guava (Psidium guajava L.) cv. 'Pant Prabhat'. In: 1st International Guava Symposium, CISH, Lucknow, 80–82.*
9. *Kundu, S. (2007). Effect of high density planting on growth, flowering and fruiting of guava (Psidium guajava L.). Acta Horticulturae 735, 267–270.*
10. *Lal, S., Tiwari, J. P. & Mahajan, A. R. (2007). Studies on planting systems in guava (Psidium guajava L.) cv. Sardar. Acta Horticulturae 735, 263–266.*
11. *Mishra, H. K. & Pathak, R. A. (1998). Effect of shoot pruning on crop regulation in guava (Psidium guajava L.) cv. 'Sardar'. Progressive Horticulture 30, 78–81.*
12. *Pathak R. K. & Ram, R. A. (2005). Integration of organic farming practices for sustainable of guava. In: 1st International Guava Symposium, CISH, Lucknow, 144–145.*
13. *Peng, Y. H. & Qin, X. N. (1993). Effect of N, K and Ca on growth and photosynthetic and physiological of citrus seedling. Journal of Fruit Science 10, 6–10.*
14. *Prabu, T., Narwadkar, P. R., Sajindranath, A. K. & Rathod, N. G. (2002). Integrated nutrient management in coriander. South Indian Horticulture 50, 680–684.*
15. *Roose, M. L., Coel, D. A., Atkin, D. & Kuper, R. S. (1986). Yield and tree size of four citrus cultivars on 21 rootstocks in California. J. American Soc. Horti. Sci., 114, 135–140.*

16. *Schnitzer, M. (1991). Soil organic matter for the next 75 years. Soil Sciences 151, 41– 59.*

17. *Shukla, A. K., Sarolia, D. K., Bhavana Kumari, R. A., Kaushik, R. A., Mahawer, L. N. & Bairwa. (2009). Evaluation of substrate dynamics for integrated nutrient management under high density planting of guava cv. Sardar. Indian Journal of Horticulture 66(4), 461–464.*

18. *Singh, G., Singh, A. K. & Mishra, D. (2007). High density planting in guava. Acta Horticulturae 735, 235–241*